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ABSTRACT

This combination progress record and course outline is designed for use by individuals teaching a course in automobile repair. Included among the topics addressed in the course are the following: shop safety, engines, fuel and exhaust systems, electrical systems, crankcase lubrication systems, cooling systems, power transmission systems, steering systems, brake systems, frame and suspension systems, air conditioning, emission controls, manual metal arcs, and automotive applications of gas welding. In addition to the theory outline, which includes space for recording information concerning the scheduling and presentation of the lesson material, this record book also contains a list of course objectives for grades 11 and 12 and a grid for use in recording the individual student's mastery of each specific skill taught in the course. (MN)

PROGRESS RECORD

AND

THEORY OUTLINE

AUTOMOBILE COURSE

DIVISION OF VOCATIONAL-TECHNICAL SCHOOLS

CONNECTICUT DEPARTMENT OF EDUCATION

1983-1984

PREFACE

This course outline is to be used with the trade analysis and it should be integrated with the progress record.

Although the course outline mentions safety only in a few areas, it is the responsibility of the instructor to examine the analysis as well as to draw on his own experience to be sure that the students are alerted to and practice the necessary safety procedures required for each job.

AUTOMOTIVE
COURSE OBJECTIVES

GRADE 11 & 12

1. To maintain the ability and desire to work and live harmonisouly together with mutual respect for the rights of others.

2. To apply each students understanding of scientific and mechanical principles as well as manual skills to the repair of vehicles using production (real) jobs as a means to meet the specific course requirements.

3. To safely and correctly use and care for the basic automotive tools and diagnostic equipment.

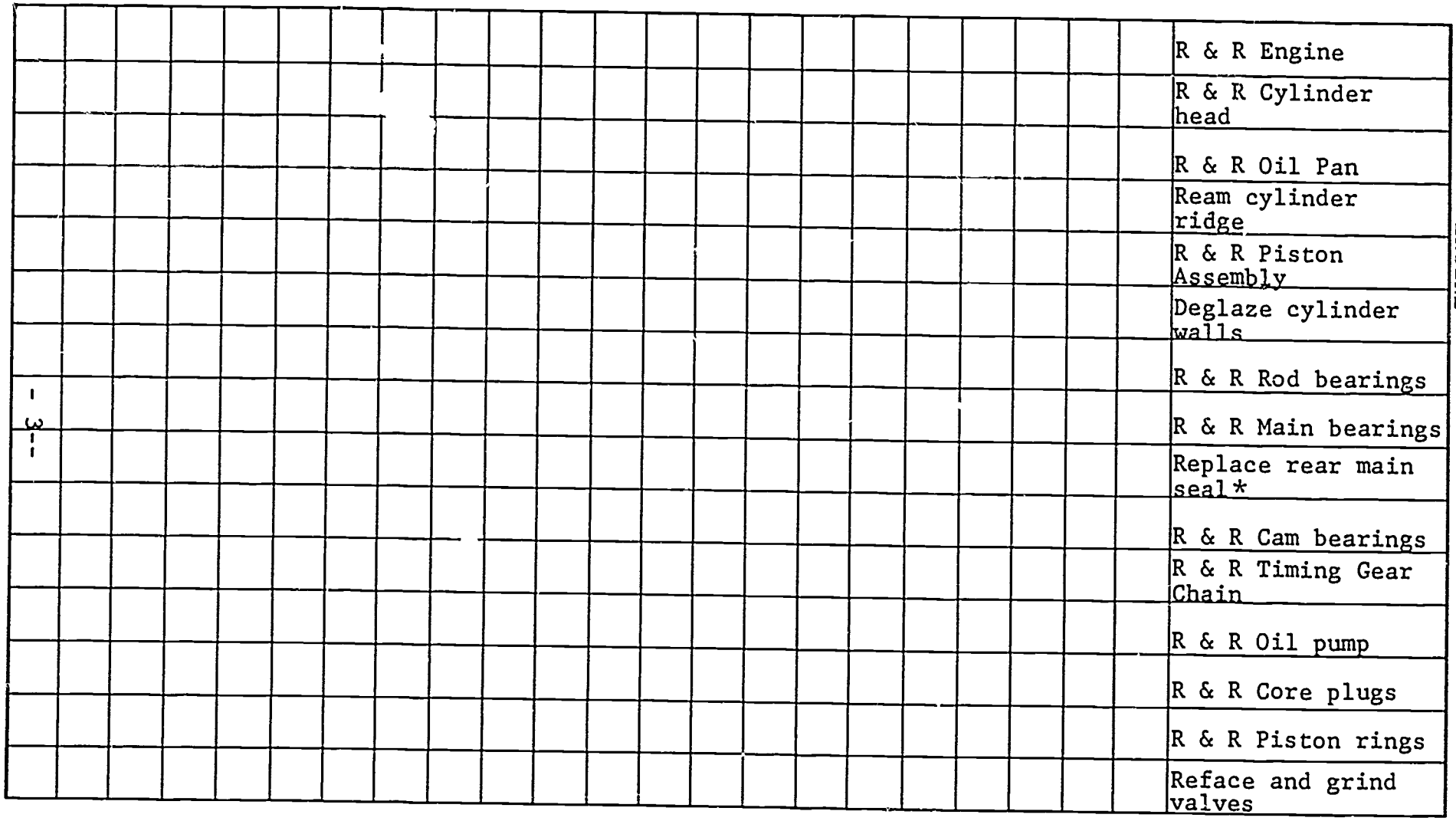
4. To apply practical skills and related technical knowledge of the trade in sufficient degree to meet minimum job entry requirements in the automotive trade.

5. To approach each job and assignment with a logical step by step diagnostic procedure.

6. To practice good work habits of orderliness and care of property.

7. To practice safe work habits and to promote safety consciousness.

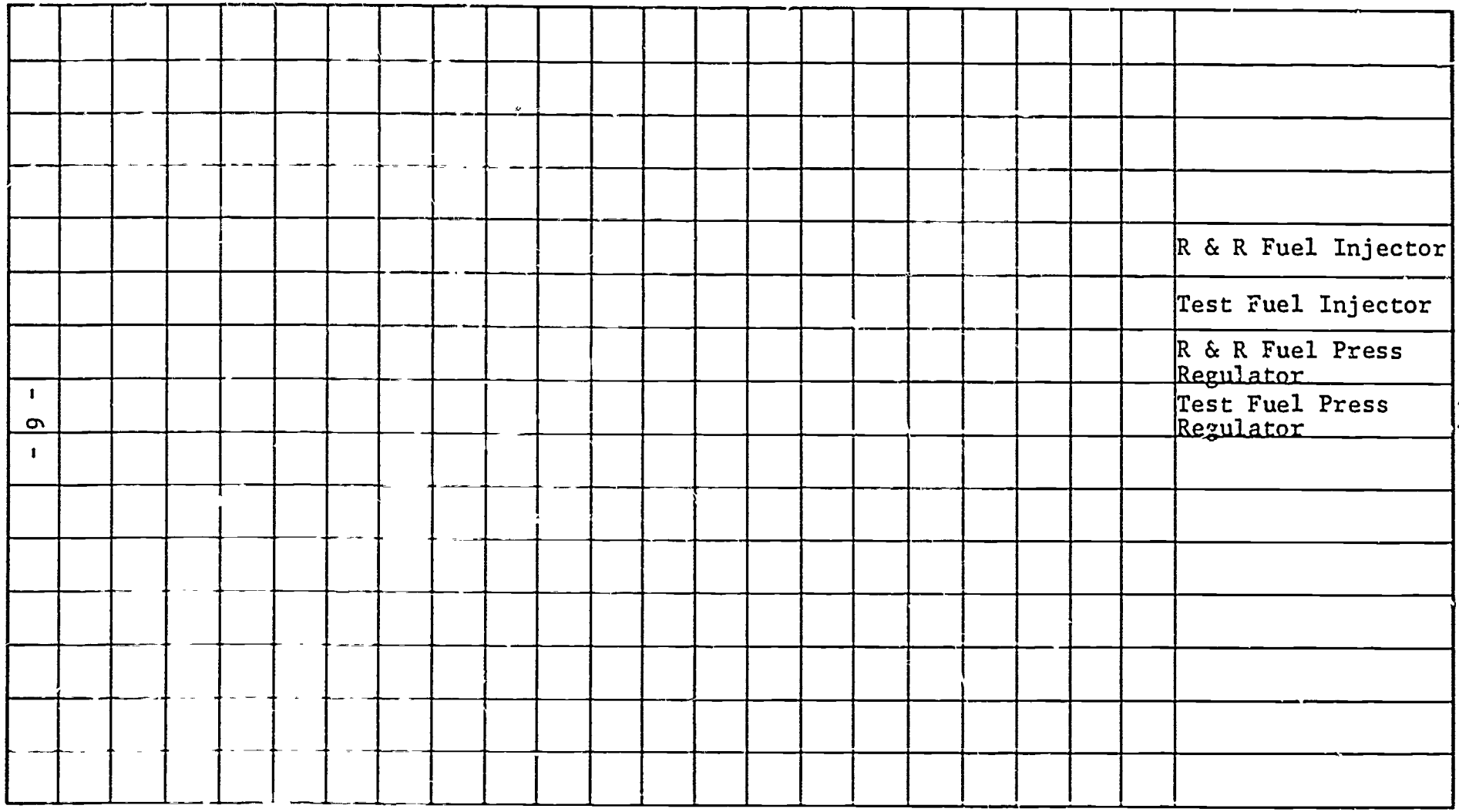
8. To be able to estimate job costs and part requirements.

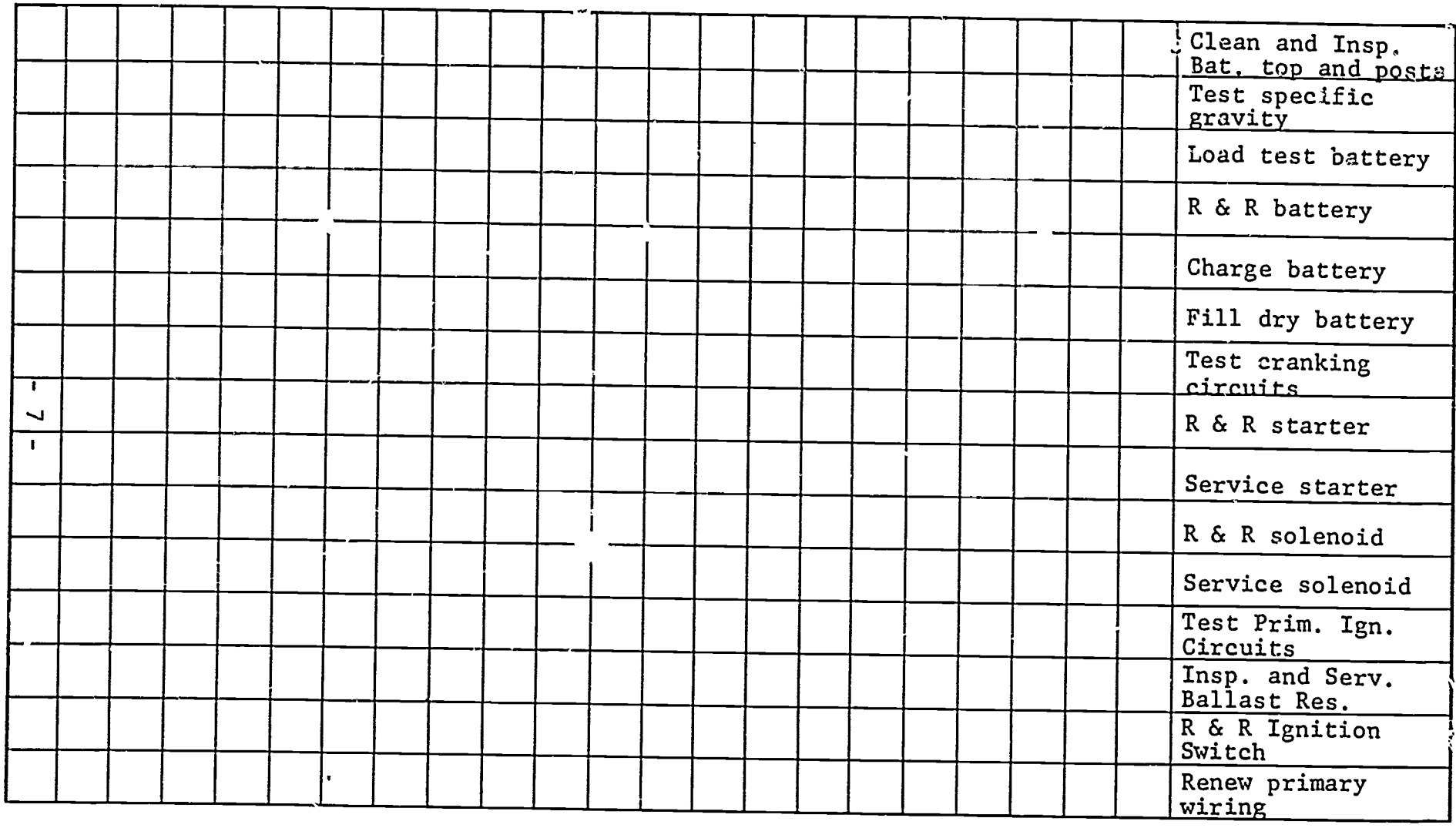


- R & R Engine
- R & R Cylinder head
- R & R Oil Pan
- Ream cylinder ridge
- R & R Piston Assembly
- Deglaze cylinder walls
- R & R Rod bearings
- R & R Main bearings
- Replace rear main seal*
- R & R Cam bearings
- R & R Timing Gear Chain
- R & R Oil pump
- R & R Core plugs
- R & R Piston rings
- Reface and grind valves

Serv. Rocker arm shaft
Insp. & Serv. Hydraulic lifters
Plastic Gauge bearings*
Check and Service Valve guides*
Test and Clean air filter
R & R Fuel filter
Test fuel pump and system
R & R Fuel Pump
Service carburetor
R & R Gas tank
R & R Sending Unit

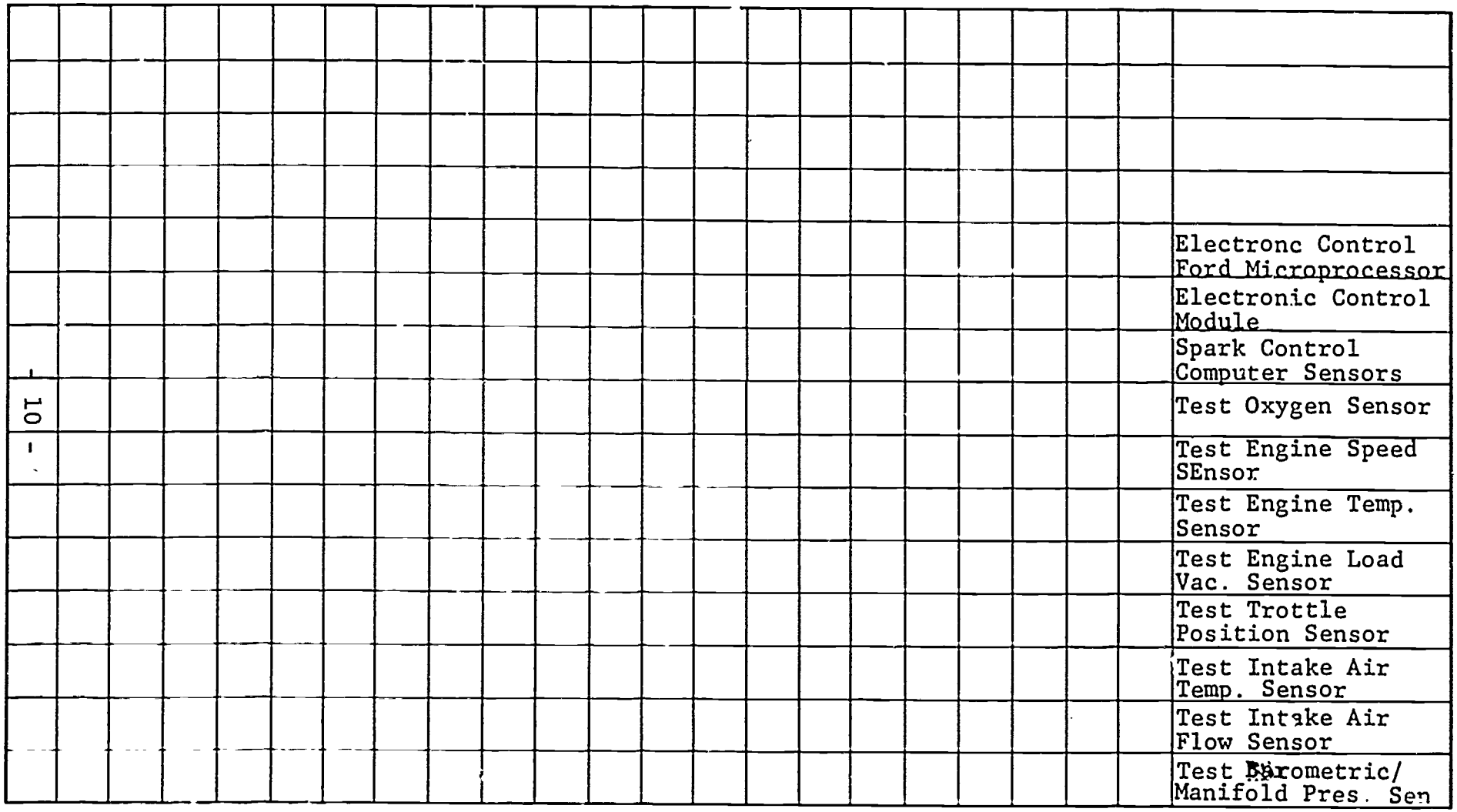
R & R Dash Unit
R & R Heat riser valve
R & R Exhause Pipe
R & R Muffler
R & R Tail pipe
Serv. Thermo Cont. Air Cleaner*
Serv. Vac. Oper. Heat riser valve*
Insp. Evap. Cont. system lines and filter*
Serv. Charcoal Cannister & Filter*
Service Air Injector System*
Service Elec. Auto. Choke*
Serv. Cat. Converter System *
Service EGR System *
Service Decel Valve*


R & R Fuel Injector
Test Fuel Injector
R & R Fuel Press Regulator
Test Fuel Press Regulator


Clean and Insp. Bat. top and posts
Test specific gravity
Load test battery
R & R battery
Charge battery
Fill dry battery
Test cranking circuits
R & R starter
Service starter
R & R solenoid
Service solenoid
Test Prim. Ign. Circuits
Insp. and Serv. Ballast Res.
R & R Ignition Switch
Renew primary wiring

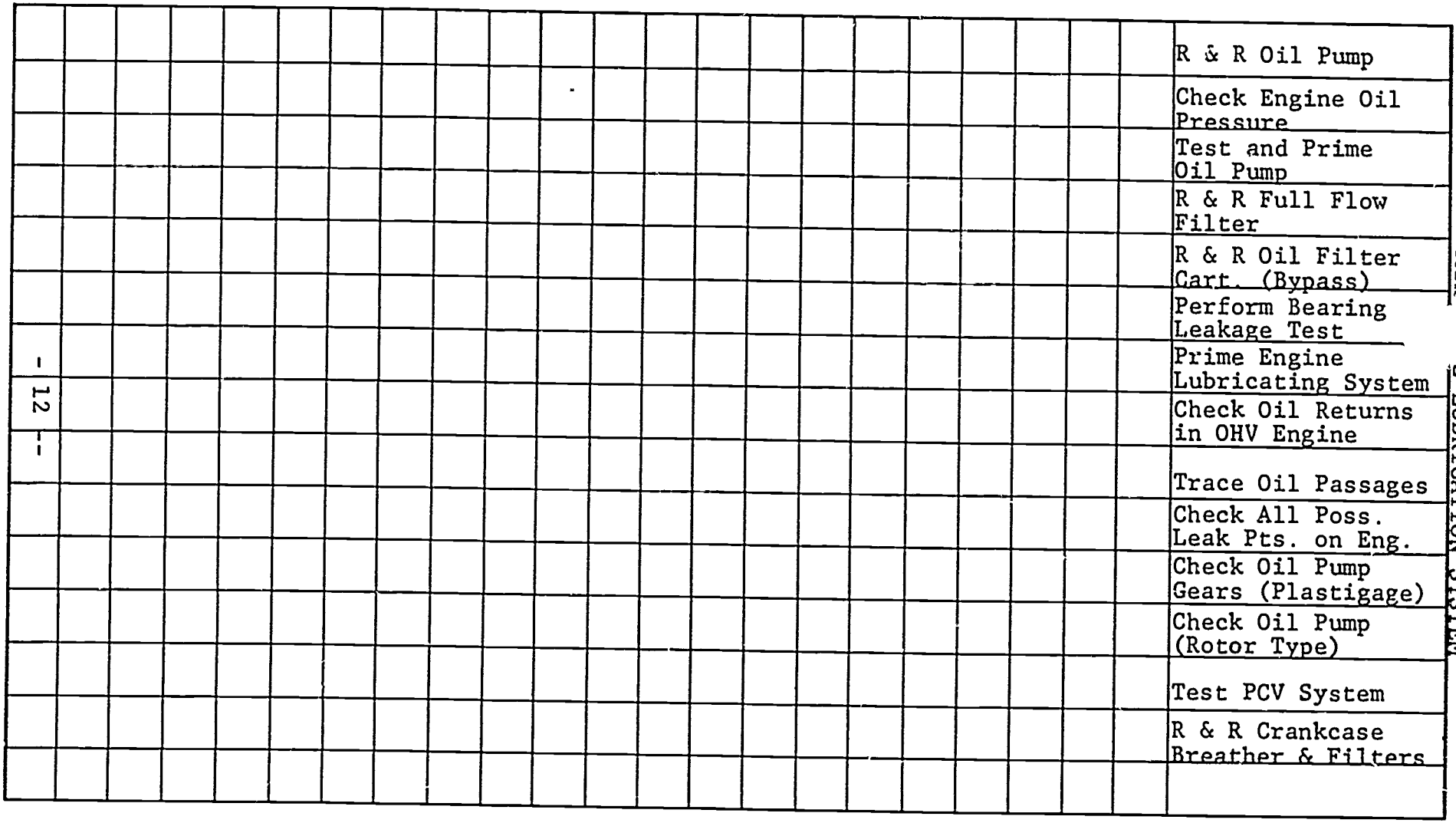
	Test secondary Ign. circuits
	Test Electronic Module *
	R & R Coil
	Service Coil
	Renew secondary wiring
	Servi..e Distri. cap
	Service Spark Plugs
	Service Points
	Service Condenser
	Service Reluctor (HEG) *
	Service Pick-up coil assembly *
	Service vacuum advance
	Service distributor
	Adjust Ignition Timing
	Test Charging Circuits

R & R Alternator
Serv. Alternator
Service diodes*
Check & adjust Alt. Reg.
R & R Seal beam
Align headlights
R & R Headlight S/W
R & R Signal S/W
R & R Stoplight S/W
Service Lighting circuits
Service dash units and gauges
Service Accessory circuits
Serv. Dist. Spark Control System
Serv. Electronic Choke System


Electronc Control Ford Microprocessor
Electronic Control Module
Spark Control Computer Sensors
Test Oxygen Sensor
Test Engine Speed SEnsor
Test Engine Temp. Sensor
Test Engine Load Vac. Sensor
Test Trottle Position Sensor
Test Intake Air Temp. Sensor
Test Intake Air Flow Sensor
Test Barometric/ Manifold Pres. Sen

DIVISION III(A)
COMPUTERIZED ENGINE CONTROLS (Cont'd)

																						Test Vehicle Speed Sensor
																						Test Fuel Temp. & Pressure
																						Test Detonation Sensor
																						Test Trans. Gear Position Sensor
																						Digital Volt
																						Ohmmeter - use with
																						(10 Mego HMS Input Impedance)


DIVISION IV - CRA
E LUBRICATION SYSTEM
R & R Oil Pump
Check Engine Oil Pressure
Test and Prime Oil Pump
R & R Full Flow Filter
R & R Oil Filter Cart. (Bypass)
Perform Bearing Leakage Test
Prime Engine Lubricating System
Check Oil Returns in OHV Engine
Trace Oil Passages
Check All Poss. Leak Pts. on Eng.
Check Oil Pump Gears (Plastigage)
Check Oil Pump (Rotor Type)
Test PCV System
R & R Crankcase Breather & Filters
- 12 --
10 / 83

Pressure Test
Test for Clogged Core
R & R Thermostat
R & R Hoses (Check for cracks)
Test Heater and Heat Valve
R & R Belts (Check for cracks)
R & R Water Pump
Check Bypass Valves
Check Trans. Cooler (Oil in water)
Check for Leaky Head Gasket
R & R Expansion Plugs

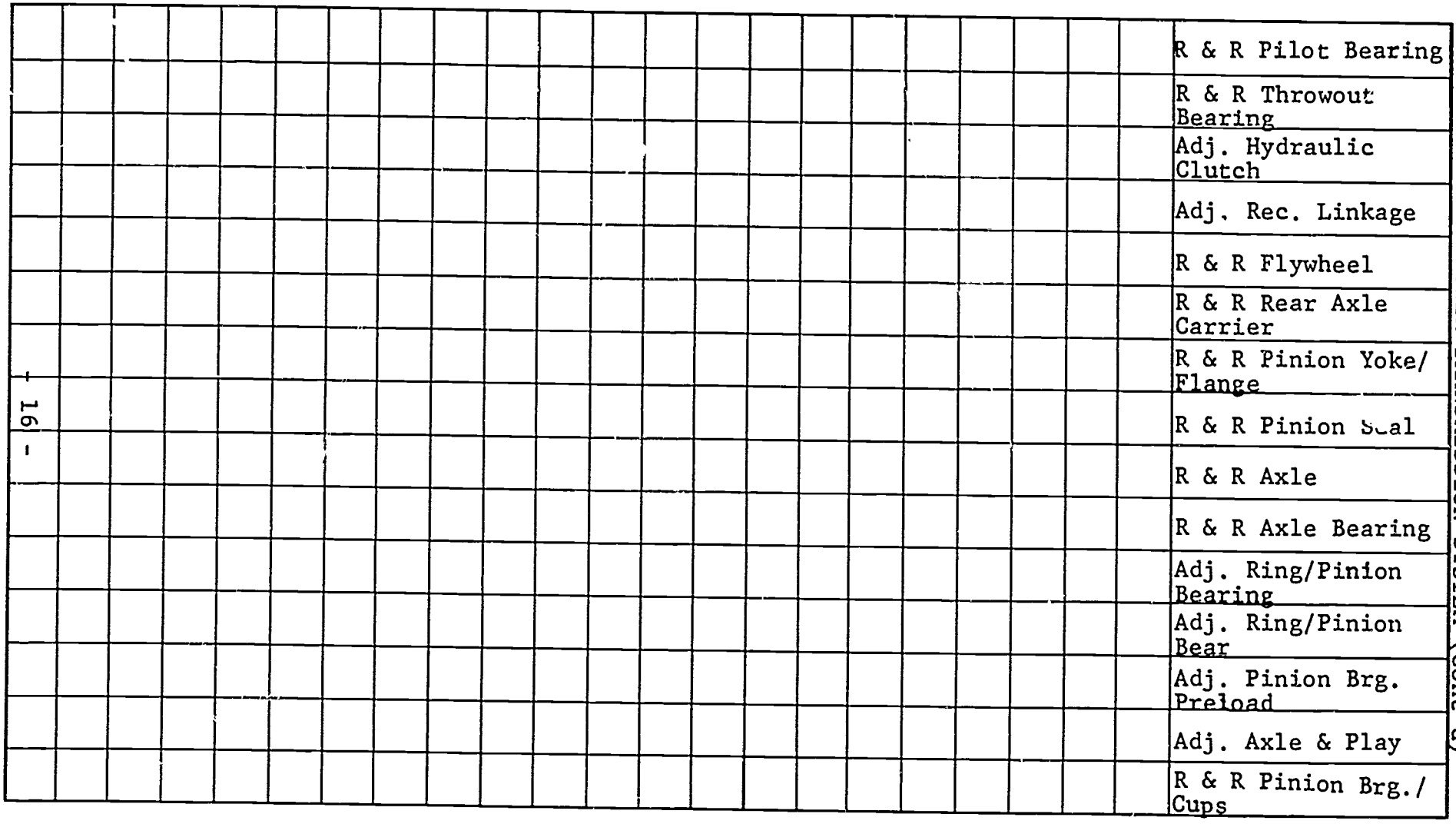
DIVISION V
COOLING SYSTEM (Cont'd)

Use of soldering iron																						
R & R Vacc. Temp. Control*																						
R & R Coolant Recovery System																						

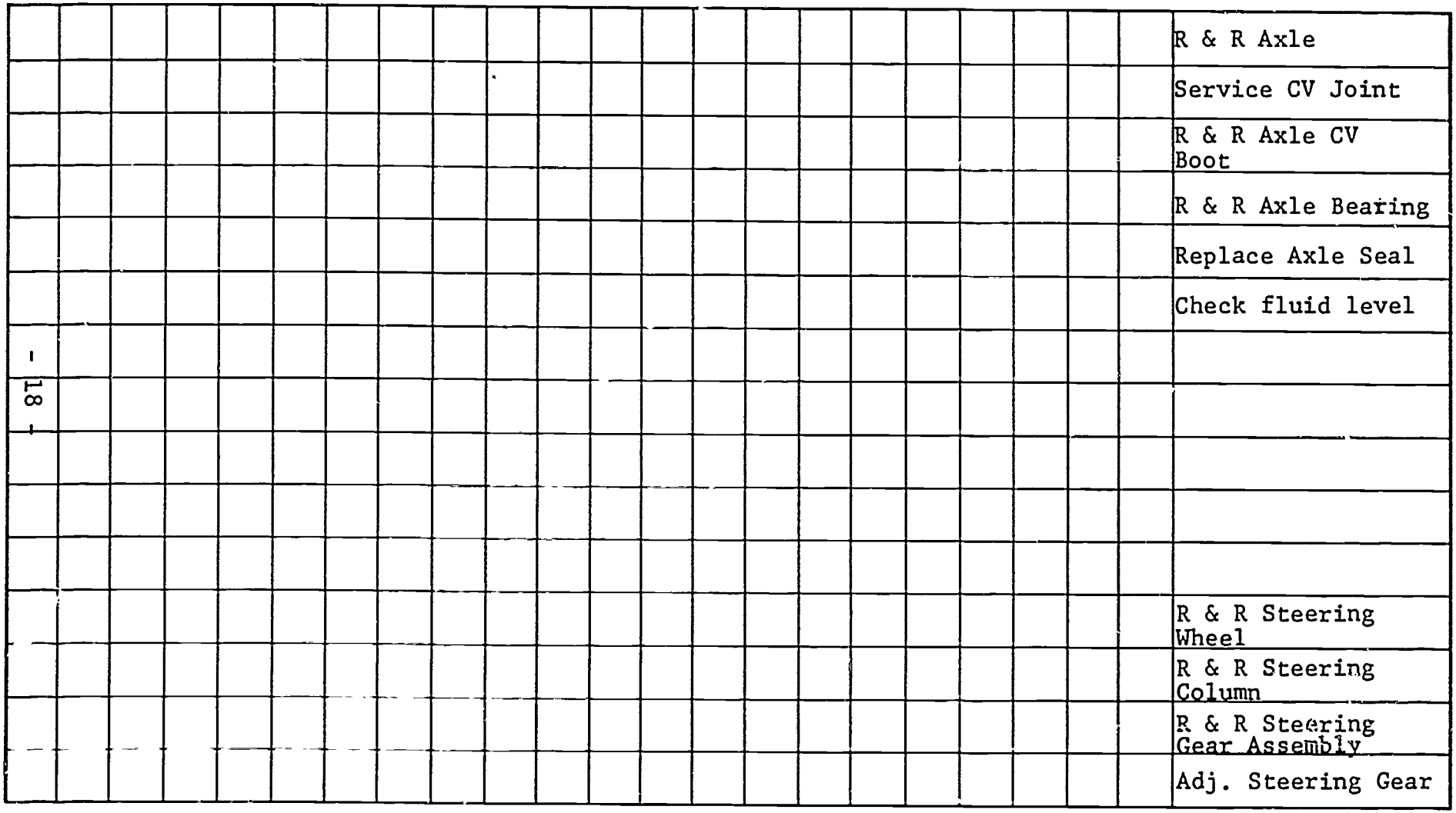
DIVISION VI
POWER TRANSMISSION SYSTEM

R & R Standard Transmission*																						
R & R Automatic Transmission*																						
Drain & refill auto. transmission																						
Check cluster shaft and play																						
Check transmission bearings																						
Dis. & assemble "U" joint																						
Adjust Auto. Transmission bands																						

	R & R Drive shaft
	Dis. & Assemble Sychn. Unit
	Dis. & Assemble Std. Transm.
	Dis. & Assemble Auto. Transm.
	Adjust Standard Transm. Linkage
	Adjust Auto. Transm. Linkage
	Check Fork Travel
	Check Shift Dts. Std. Transm.
	Air Check Auto. Transm.
	R & R Front Seal (Transm)
	R & R Rear Seal (Transm.)
	R & R Speedometer Cable
	R & R Flywheel Ring Gear
	R & R Clutch Disc
	R & R Clutch Press Plate


R & R Pilot Bearing
R & R Throwout Bearing
Adj. Hydraulic Clutch
Adj. Rec. Linkage
R & R Flywheel
R & R Rear Axle Carrier
R & R Pinion Yoke/ Flange
R & R Pinion Seal
R & R Axle
R & R Axle Bearing
Adj. Ring/Pinion Bearing
Adj. Ring/Pinion Bear
Adj. Pinion Brg. Preload
Adj. Axle & Play
R & R Pinion Brg./ Cups

R & R Carrier Brgs./Cups
R & R Std. Gears
R & R Spider Pin/ Gears
R & R Rear Brk. Drum Flange
R & R Rear Brk. Drum (Tapered)
R & R Axle Creep
R & R Transm, Spark Cont. Switch*
R & R Trans Axle Standard*
R & R Trans Axle Automatic*


DIVISION VI(A) - TRANS AXLE ONLY
DIVISION VII- STEERING SYSTEM
R & R Axle
Service CV Joint
R & R Axle CV Boot
R & R Axle Bearing
Replace Axle Seal
Check fluid level
R & R Steering Wheel
R & R Steering Column
R & R Steering Gear Assembly
Adj. Steering Gear

	Adj. Const. Control St./Lr.
	Adj. Vot. Valve St./Lr.
	Adj. Link Type St./Lr.
	Overhaul Std. Steer./Assem.
	Overhaul Power Steer./Assem.
	Overhaul Link Steer./ASsem.
	Overhaul Power Steering Pump
	R &R Power Steering Pump
	R & R Pitman Arm
	R & R Drag Link
	R & R Tie Rod
	R & R Tie Rod End
	R & R King Pin/ Bush.
	R & R Upper Knuck. Assem.
	R & R Lower Knuck. Assem.

	R & R Lower Cont. Arm Assem.
	R & R Upper Cont. Arm, Assem,
	R & R Front Coil Spring
	R & R Upper Ball Joint
	R & R Torsion Bar
	Adjust torsion bar
	Repack wheel bearings
	Adjust wheel bearings
	R & R Shock Absorbers
	R & R Stabilizer Bar/Links
	R & R Power Steering Press./Hose
	Align Front End
	Balance Wheels

	Repack Wheel Brgs.
	R & R Wheel Brgs.
	Adj. Wheel Bearings
	R & R Brake Shoes
	Inspect Wheel Cylinders
	R & R Wheel Cylinders
	Maintain Backing Plates
	R & R Disc Brake Pads
	R & R DIsc Brake Calipers
	Insp. Disc. Brake Calipers
	Rebuild Disc Brake Calipers
	Check Master Cylinder
	Overhaul Master Cylinder
	Overhaul Dual Master Cylinder
	Inspect Power Brake Unit

	Overhaul Power Brake Unit
	Flush & Bleed Brake System
	Overhaul Prop. Valves (Disc Brakes)
	Check Brake Hoses/ Lines
	R & R Brake Hoses/ Lines
	AdjustFoot Brake
	Adjust Hand Brake
	R & R Stop Light Switches
	Reface Drums
	RefaceDiscs

Check for wear
R & R Coil Springs
R & R Control Arms
R & R Torsion Arms
R & R Shocks
R & R Stabilizer Bar or Linkage
R & R Ball Sockets
R & R Tie-Rod Ends
R & R Rear Coil Springs
R & R Leaf Type Springs
R & R Shackles
Check for Tracking
Check for Bent Frame
Check Trim Height
Balance Wheels

Align Wheels
R & R McPherson Struts
Test Air Cond. System for Leaks
Connect Manifold Gauges
Troubleshoot Air Cond. System
Evacute Air Cond. System
Replace Evaporator
R & R Expansion Valve
R & R Suction Throttling Valve
Replace Condenser

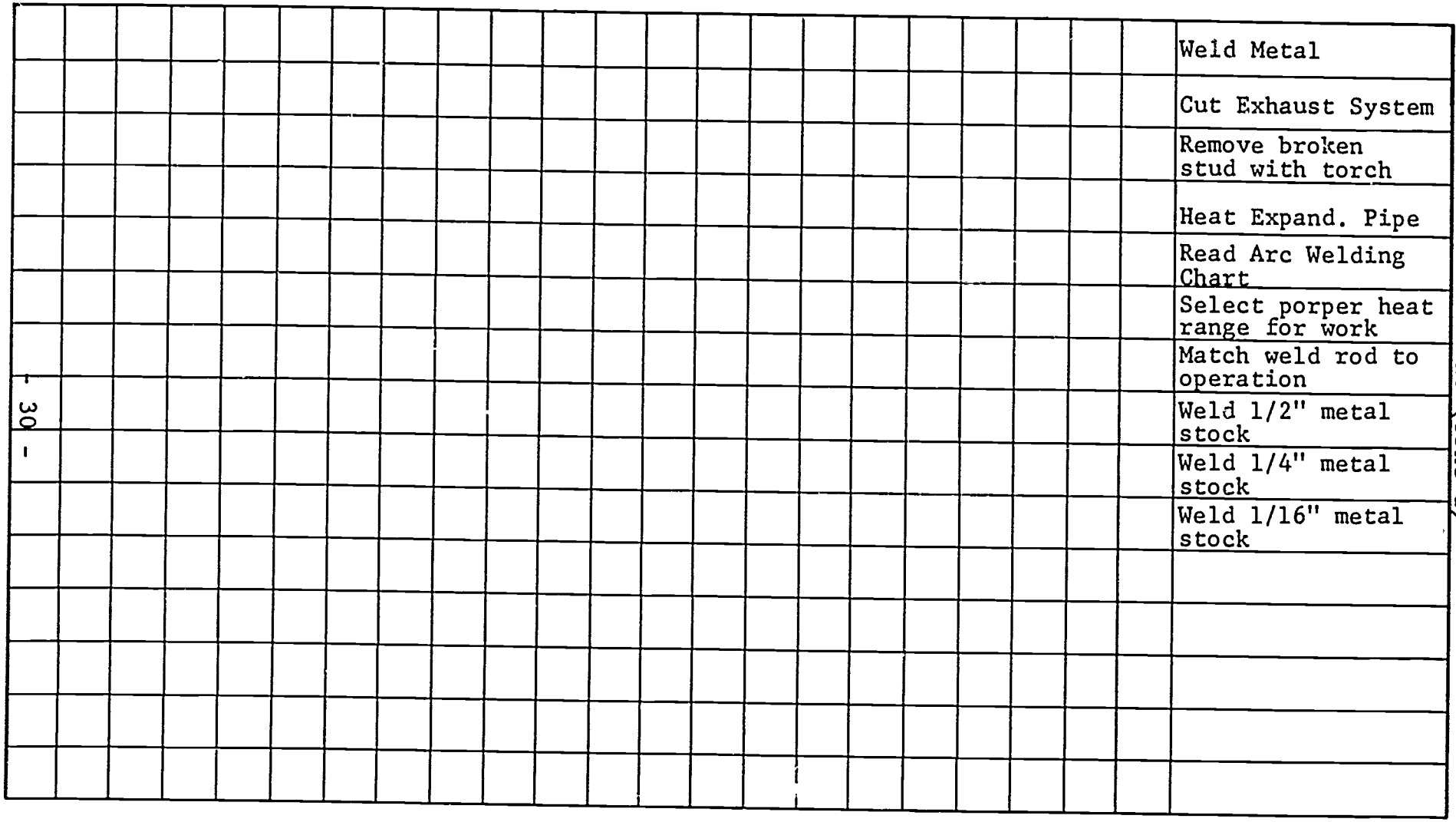
	R & R Receiver Dryer
	R & R Compressor
	R & R Compressor Clutch
	R & R Compressor Seals
	R & R Comp. Valve Plate & Hd. Gasket
	R & R Compressor Hoses
	Check & Fill Compressor Oil
+ 25 -	R & R Compressor Belts
	Purge Air Cond. System
	Charge Air. Cond. System
	Service and adjust controls
	Troubleshoot Auto Temp. Cont. System

Serv. Thermo Cont. Air Cleaner*
Serv. Vac. Oper. Heat Riser Valve*
Insp. Evap. Cont. System Lines & Filter*
Serv. Char. Cannister & Filter*
Service Air Inj. System*
Serv. Elect. Auto. Choke*
Serv. Cat. Convertor System*
Serv. EGR System*
Service Decel Valve*
Serv. Dist. Spark Cont. System*
Test PCV System*
R & R Temp. Sens. Vac. Valves*
Test Ex. Emiss. w/Ex. Gas Analyzer*

	Adj. Carb. w/ Limiter Caps*
	Adj. Carb. w/Idle Lim. Needles*
	Serv. Elect. Spark Cont. System*
	Serv. Elect. Ignition System*
	Remove PCV Valve*
	Shake, Listen for Rattle
	Remove Valve - Check for Vac.
	Idle Drop Test
	Check All Vapor Ls.
	Check Cannister for Cracks
	Change Filter
	Check Purge Valve
	Cool Temp. Sensor
	Watch Damper Valve
	Check all Vacuum Hoses

R & R Air Pump
Change Filter
R & R Divertor Valve
R & R Check Valve
Check Air Del. System
Check Vacuum Hoses
R & R EGR Valve
Clean Intake Ports
Check Valve for Movement
Check Vacuum Lines
Check Engine Speed Test
R & R Manifold Heat Valve
R & R Power Actuator
Vacuum Test Actuator

	R & R Temp. Switch
	R & R EFE Oil Temp. Switch
	R & R Catalytic Convertor
	R & R Platinum & Palladium
	R & R Welding Tank
	R & R Welding Gauges
	Purge Lines
	Clean Torch Tips
	Adjust Regulators
	R & R Tips & Cutting Torch
	Adjust Flame
	Braze Metal


Weld Metal
Cut Exhaust System
Remove broken stud with torch
Heat Expand. Pipe
Read Arc Welding Chart
Select porper heat range for work
Match weld rod to operation
Weld 1/2" metal stock
Weld 1/4" metal stock
Weld 1/16" metal stock
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THEORY OUTLINE INDEX

AUTOMOBILE COURSE

THEORY OUTLINE

LESSON PLAN NO.	DATE SCHEDULED	DATE PRESENTED	DATE TESTED

I. SHOP SAFETY

A. Personal Safety of the Auto Mechanic

1. His value to his family

   a. As a wage earner
   b. Loss of earning power if permanently injured

2. His value to his employer

   a. Loss of company income
   b. Loss of a trained employee

3. His clothing

   a. Approved shop clothing
   b. Hard-toe safety shoes
   c. Remove rings and metalbanded wrist watches while at work

4. Safety glasses

B. Building Equipment Safety

1. Location of entrances and exits
2. Fire fighting equipment: type and location
3. Exhaust system
4. Safety information - availability by telephone
5. Hazard areas well marked
6. Waste storage
7. Possible insurance company restrictions
8. Use of jack stanchions
9. Hydraulic equipment inspection
10. Jack handle trigger use
11. Hoists
12. Heating fans
13. Electrical outlets-and cords
14. A place for all equipment
15. A routine cleaning and inspection schedule.

C. Tool Safety

1. Proper use of hand tools
2. Evaluation of tool conditions
3. Selection of proper tool for the job at hand
4. Caution against carrying sharp hand tools in pockets

LESSON PLAN NO.	DATE SCHEDULED	DATE PRESENTED	DATE TESTED

5. Dangers of high-speed tools
6. Air-tool maintenance and safety
7. Dangers of air jacks
8. A tool rack for hand tools

D. Chemicals Safety

1. Hot tank chemicals and hazards
2. Cold tank chemicals and hazards
3. Steam cleaning chemicals and hazards
4. Skin protection when using chemicals
5. Eye protection when using chemicals
6. Batteries
7. Gasoline
8. Storage of inflammables and toxics

E. Electrical Equipment

1. Importance of grounding electrical tools
2. Condition of electrical tool cords
3. Individual equipment safety
   a. Dangers of bench grinders and importance of guards and eye shields
   b. Dangers of wire wheels and importance of guards and eye shields

F. Safety While Servicing the Automobile

1. Cooling system safety
2. Fanbelts
3. Fans
4. Pulleys
5. Air cleaner and fire arrester
6. Safety while road testing the automobile
7. Exhaust manifold

II. THE ENGINE

A. Safety

B. Automobile Manufacturers and Makes of Cars not Over Eight Years Old

1. General Motors Corporation
2. Ford Motor Company
3. Chrysler Motors Corporation
4. American Motors
5. Imports (leading)
6. Engine types
7. Principles of engine operation
8. Principles of the four-stroke cycle engine
9. Principles of the two-stroke cycle engine

LESSON PLAN NO.	DATE SCHEDULED	DATE PRESENTED	DATE TESTED

C. Engine Components and Their Function

1. Head, cylinder block
2. Valves and valve mechanisms
3. Pistons and connecting rod assemblies
4. Crankshafts and bearings

III. THE FUEL AND EXHAUST SYSTEM

A. Safety

B. Fuel System Components and Their Function

1. Fuel tank
2. Fuel lines
3. Fuel pump
4. Carburetor
5. Air cleaners
6. Fuel filters

C. Fuel Tank

1. Construction
2. Venting system
3. Tank - gas-gauge unit

D. Fuel Lines

1. Steel lines
2. Flexible lines
   a. Visual inspection
   b. Procedure for removing and replacing
   c. Procedure for flaring a gas line
   d. Types of fittings and connections used

E. Fuel Pump

1. Types of pumps
   a. Single action - mechanical
   b. Electric
2. Principles of pump operation
   a. Single action - mechanical
   b. Electric

F. Testing the Fuel Pump

1. Pressure test
2. Volume test
3. Vacuum test
   a. At pump
   b. At end of flexible line
   c. At tank connections
4. Oil dilution

LESSON PLAN NO.	DATE SCHEDULED	DATE PRESENTED	DATE TESTED

G. Manifold Heat Control Valve

1. Purpose of the valve
2. Checking and servicing the valve

H. Carburetor Fundamentals

1. Air fuel ratio definition
2. Fluids and air flow - pressure vs. vacuum
3. Pressure vs. air velocity
   a. Venturi action
   b. Types of venturi
4. Carburetor venting
   a. External
   b. Internal

I. Components of Carburetors and Their Function

1. Float
   a. Needle and seat
   b. Float pontoon
2. Idle
   a. Calibrated idle tubes
   b. Air bleeds
   c. Discharge holes
   d. Mixture screws
3. Off-idle
   a. Discharge holes
   b. Main discharge nozzles
4. High-speed circuit
   a. Main metering jets
   b. Main discharge nozzles
5. Power circuit
   a. Power valve
   b. Power piston or diaphragm
   c. Vacuum passages
   d. Check balls
6. Pump circuit
   a. Pump plunger or diaphragm
   b. Discharge check ball or needle
   c. Intake check ball
   d. Discharge passage
   e. Pump linkage

LESSON PLAN NO.	DATE SCHEDULED	DATE PRESENTED	DATE TESTED

J. Carburetor Service Needs

1. Specifications
2. Special tools and gauges
3. Trouble-shooting
4. Cleaning chemicals
5. Carburetor kits
   a. Gasket kit
   b. Service kit

K. Components of Fuel Injection

1. Throttle body
2. Fuel pressure regulator
3. Injectors and hardware

IV. THE ELECTRICAL SYSTEMS

A. Safety

B. Battery Components and Construction

1. Plates
2. Electrolyte solution
3. Separators
4. Case and caps

C. How the Battery Works

1. Chemical action in the battery
   a. Charging action
   b. Discharging action
   c. Significance of specific gravity
   d. Effects of voltage and state of charge on charging rates
2. Causes of battery failures
   a. Overcharging
   b. Undercharging
   c. Freezing
3. Battery maintenance and storage
   a. Storage problems
   b. Wet-type battery
   c. Dry-type battery
4. Continual maintenance
   a. Trickle charge
   b. Slow charge
   c. Fast charge
   d. Booster charge
   e. Maintenance of cables and terminals

LESSON PLAN NO.	DATE SCHEDULED	DATE PRESENTED	DATE TESTED

D. Introduction to the Basic Circuits

1. Charging circuit
2. Cranking circuit
3. Lgnition circuit
4. Lighting and accessory circuit
5. Descriptive definition and purpose of each circuit

   a. Charging circuit

6. Cranking circuit

   a. This circuit cranks the engine and is of vital importance in starting

7. Ignition
8. Bench testing the generator

   a. Rotor testing
   b. Shorts
   c. Grounds
   d. Opens

9. Starter testing

   a. Shorts
   b. Grounds
   c. Opens
   d. Delta
   e. Y type

10. Case Testing

    a. Inspect and test for grounded terminals
    b. Inspect and test for grounded heat sink
    c. Diode testing
    d. Check brush holders and brush-spring tension

E. D. C. Charging Circuit

1. Regulation or limiting action of the charging circuit

   a. Function of the cutout relay
   b. Function of the current limiter
   c. Function of the voltage limiter
   d. Single contact
   e. Double contact

2. Location and purpose of relay

   a. Cutout relay
   b. Current limiter
   c. Voltage limiter

LESSON PLAN NO.	DATE SCHEDULED	DATE PRESENTED	DATE TESTED

3. Effect of temperature on regulation
4. Application of charging-circuit voltage potential as it applies to charging the battery
5. Adjustments and cautions pertaining to regulator service
   a. Cutout relay
   b. Opening current
   c. Closing voltage
   d. Current limiter
   e. Voltage limiter
   f. Air-gap adjustments
6. Adjusting the circuit to customer driving habits
7. Regulator specifications
   a. Where to locate specifications
   b. General specifications vs. complete temperature effect charts

F. Generator Components D.C.

1. Brush and brush-holder assembly
   a. Commutator
   b. Armature
   c. Pole shoes
   d. Field coils
   e. Bearings
   f. End-frame assemblies
   g. Pulley (sizes)
2. Principles of generator operation
   a. Magnetic principles
   b. Brush and commutator action
3. Types of circuits
   a. A-type generator
   b. B-type generator

G. A. C. Charging Circuit

1. Regulator classification
   a. Electro-magnetic
   b. Single-unit regulator
   c. Two-unit regulator
   d. Three-unit regulator
2. Transistor
   a. Transistorized regulators
   b. Transistor regulators

LESSON PLAN NO.	DATE SCHEDULED	DATE PRESENTED	DATE TESTED

3. Principles of regulator operation
   a. Single-contact voltage control
   b. Double-contact voltage control
   c. Circuit-Breaker relay
   d. Control relays
   e. Transistorized regulation
   f. Transistor regulation
4. Components of typical A.C. charging circuits
   a. Delco-Remy circuits
   b. Chrysler circuit
   c. Leece-Neville circuit
   d. Ford circuit
   e. Motorola circuit
5. Analyzing charging system malfunctions
   a. Full-charged battery - high-charge rate
   b. Low charged battery - low-charge rate
   c. Low charged battery - no charge rate
   d. Excessive arcing at the regulator contact points
6. Electrical Checks and Adjustments
   a. Importance of regulator voltage adjustment and regulator ambient temperature
   b. Circuit-resistance test
   c. Generator output test
   d. Voltage control tests and adjustments
   e. Tailoring voltage regulator settings to battery state of charge
7. Generator Nomenclature A.C.
   a. Brush assembly
   b. Rotor segments
   c. Starter assembly
   d. Slip rings
   e. Fan and pulley assembly
   f. Bearings
   g. End frame assemblies
   h. Diode replacement
8. Principles of Operation
   a. Magnetic principles
   b. Development of single phase sine wave
   c. Development of three phase sine wave
   d. Principles of rectification
   e. Rectifiers
   f. Diodes

LESSON PLAN NO.	DATE SCHEDULED	DATE PRESENTED	DATE TESTED

9. Components of each circuit
    a. Charging circuit
    b. Battery
    c. Generator
        1) D. C. type
        2) A. C. type
    d. Regulator or control device

II. Purpose of the Starter
    1. Magnetic principles as they pertain to starter operation
    2. Function and construction of starters and starting circuits
    3. Function and construction of switches
        a. Solenoid
        b. Magnetic
    4. Function and construction of starter drives
        a. Bendix
        b. Overrunning
        c. Dyer
        d. Gear reduction-type drives
    5. Typical Service Problems
        a. Starter clincks but does not turn
        b. Machine gunning
        c. Starter disengages too soon
        d. Starter turns but does not engage
        e. Locked starter drive
        f. Slow-turning starter

I. Ignition Circuits
    1. Function of the ignition circuit
        a. Primary circuit
        b. Secondary circuit
    2. Components of the primary circuit
        a. Battery
        b. Ammeter
        c. Ignition switch
        d. Primary coil winding
        e. Contact points
        f. Condenser
        g. Ground wires
        h. Primary wiring harness

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3. Components of the secondary circuit
   a. Secondary coil windings
   b. Distributor cap and rotor
   c. Spark plugs
   d. Secondary wiring harness
4. Function, construction, and operation of primary units
   a. Coil
   b. Contact points
   c. Explanation of point dwell
   d. Relationship of point gap to point dwell angle
   e. Relationship of point dwell to ignition timing
   f. Point geometry
   g. Condenser
5. Function, construction, and operation of secondary units
   a. Coil
   b. Distributor cap and rotor
   c. Secondary wires
   d. Resistor wire vs. copper wire
   e. Effects of copper wire when used with distributor caps with aluminum tower inserts
   f. Spark plugs
   g. Heat ranges
   h. Conversion charts
6. Distributor: Construction and operation
   a. Single and dual contact set installations
   b. Mechanical advance
   c. Vacuum advance
   d. Combined mechanical and vacuum advance
   e. Vacuum controlled single advance
   f. Distributor timing
   g. Manufacturer's recommendations
   h. Allowable limits
7. Effect of distributor wear on ignition timing
   a. Contact set rubbing block
   b. Breaker cam
   c. Breaker plate

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8. Distributor lubrication
    a. Contact points rubbing block and pivot
    b. Breaker cam
    c. Breaker plate
    d. Bushing
    e. Advance mechanism
9. Factors affecting contact point life
    a. Condenser
    b. Charging circuits
    c. Idling and low-speed operation
    d. Moisture
    e. Over-lubrication
    f. Misalignment
    g. Careless installation
10. High energy ignition
    a. Reluctor in distributor
    b. Pickup coil assembly in distributor
    c. Electronic module
    d. Manufacturer's specifications as per type of system
        1) Ford
        2) General Motors
        3) Chrysler
        4) American Motors
        5) Imports

J. Computerized Engine Controls
1. Absolute manifold pressure
2. Engine RPM
3. Coolant temperature
4. Intake manifold air temperature
5. Throttle position
6. EGR solenoid
7. Fuel pump
8. Fast-idle valve
9. Group I injection valves
10. Group II injection valves

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V. CRANKCASE LUBRICATING SYSTEMS

A. Introduction to Crankcase Lubrication System

1. Components of the crankcase lubrication system
2. Description of the crankcase ventilation system
3. Description of various oil-feed systems
4. Description of oil pump and relief valve operation

B. Lubrication Needs of the Engine

1. Engine oil change
2. Filter change
3. Lubricate distributor, generator, and starter
4. Service oil filter breather cap and crankcase breather filter
5. Service positive crankcase ventilation system and valve

VI. THE COOLING SYSTEM

A. Introduction to the Cooling System

1. Components of the cooling system
2. Description of air cooled system

B. Function of the Cooling System

1. Absorption of heat
2. Circulation of heat to the regulator
3. Radiation of heat to passing air
4. Control of temperature

C. Components of the Cooling System

1. Radiator and radiator cap
2. Water pump and fan
3. Fan belts
4. Radiator hose connections
5. Block and heat cooling chambers
6. Cooling system gaskets
7. Heater radiator
8. Heater hose connections
9. Thermostat types
10. Coolant mixes under special conditions
    a. Air conditioning
    b. High altitude
    c. Aluminum blocks
11. Vacuum valve water controlled

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D. Classification of Cooling System Malfunctions

1. Overheating
2. External leakage
3. Internal leakage
4. Overcooling

VII. THE POWER TRANSMISSION SYSTEM

A. Introduction to Transmissions and Transaxle

1. Components of the clutch assembly
2. Description of clutch operation
3. Types of transmissions and transaxle
   a. Automatic
   b. Standard
   c. Overdrive
4. Description of fluid coupling operation
5. Description of torque convertor operation
6. Description of the transaxle operation
7. Description of drive line components

B. Transmission Fundamentals - Function and Operating characteristics of

1. A Fluid coupling
2. A torque converter
3. The planetary gear set
4. Control valves and servo-mechanisms
5. Transmission cooling

C. Maintenance and Adjustment Requirements

1. Fluid level requirements
   a. Check type used
   b. Check and add fluid
   c. Drain and refill

D. Linkage and Switch Adjustment

1. Neutral safety switch
2. Throttle linkage
3. Gear shift control linkage
4. Anti-stall dashpot clearance

E. Towing procedures and safety

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VIII. THE STEERING SYSTEM

A. Introduction to Manual Steering Gears

1. Purpose of the steering gear
   a. As a link between the driver and the wheels
   b. As a device to produce mechanical advantage for steering effort

2. Identification of steering gears
   a. By manufacturer's trade name or symbol
   b. By physical construction
   c. By automobile application

3. The importance of steering gear adjustment to the alignment job
   a. Automobile asafety
   b. As a means of extending the service life of the steering gear

4. Mechanical service procedure
   a. Preliminary inspection of steering gear and linkage
   b. Interpreting specifications
   c. Proper methods of disconnecting steering gear from steering linkage
   d. Locating register marks for steering wheel and pitman arm
   e. Measuring steering gear preload
   f. Using manufacturer's special service tools
   g. Lubricating the steering gear

5. Basic power steering

IX. THE BRAKE SYSTEM

A. Braking principles

1. Define braking action
   a. Kinetic energy
   b. Heat
   c. Generation by friction
   d. Dissipation
   e. Transfer of energy

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2. Define friction

   a. Conditions
   b. Static
   c. Moving

3. Factors controlling friction

   a. Area of contact
   b. Pressure
   c. Material
   d. Surface finish

4. Coefficient of friction

   a. Surface
   b. Force

5. Products of friction

   a. Heat
   b. Wear

6. Brake friction requirements

   a. Stopping distance
   b. Front of rear ratio
   c. Side to side balance

B. Hydraulic Principles

1. Pressure applied to liquids

   a. Noncompressable characteristic
   b. Pascal's principle for liquids under pressure

2. Multiplying force

   a. Relationship of force multiplication to cylinder areas
   b. Relationship of force multiplication to distance and speed

3. Application to the brake system

   a. Transmission of efforts
   b. Multiplication of force

C. Hydraulic System Components - Disc and Drum Type

1. Master cylinder

   a. Function
   b. Types
   c. Nomenclature
   d. Principle of operation
   e. Reconditioning

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2. Brake Lines

   a. Function
   b. Types
   c. Service procedure
   d. Warning devices
   e. Proportioning valve

3. Wheel Cylinder

   a. Function
   b. Types
   c. Nomenclature
   d. Operating principle
   e. Reconditioning

4. Brake Fluid

   a. Function
   b. Requirements
   c. Replacement

5. Mechanical Components

   a. Brake pedal and linkage
   b. Function
   c. Types
   d. Mechanical advantage

6. Service Procedure

   a. Lubrication
   b. Adjustment

7. Brake Drums

   a. Function
   b. Types
   c. Internal

8. Materials and construction - drums

   a. Pressed steel
   b. Cast iron
   c. Cast iron with steel back
   d. Combination of pressed steel with centrifugally cast metal liner
   e. Cast aluminum with cast iron liner

9. Service Procedure - Drums

   a. Removal and replacement
   b. Inspection
   c. Reconditioning

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10. Brake Shoes
    a. Function
    b. Types
    c. Pressed steel
    d. Service procedures
    e. Cleaning
    f. Inspection

11. Brake Linings - Brake Pads
    a. Function
    b. Types
    c. Woven
    d. Rigid molded

12. Methods of attaching
    a. Riveting
    b. Bonding

13. Brake Show and Lining Service
    a. Cleaning
    b. Inspection
    c. Fitting lined shoes to drum
    d. Purpose
    e. Contact requirements
    f. Methods of grinding

14. Braking Plate
    a. Function
    b. Types

15. Disc Brake Types
    a. Chrysler self-adjusting
        1) Description
        2) Application
    b. Caliper
        1) Description
        2) Application

X. THE FRAME AND SUSPENSION SYSTEM

A. Purpose of Wheel Alignment

1. Safety
2. Vehicle driving ease
3. Prevention of abnormal tire wear

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B. History and Evolution of the Suspension System

1. Invention of the wheel
2. Wagon or buggy system
3. "I" beam or solid axle
4. Independent suspension
   a. Parallel arm suspension
5. Spring design and application
   a. Leaf springs
   b. Coil springs
   c. Torsion bar suspension
   d. Air suspension
   e. Shock absorbers
   f. Wheels and tires

C. Suspension System Types

1. Front suspension systems
   a. "I" beam or solid axle
   b. Types of springs and shackles
2. Independent Suspension Systems
   a. King-pin type
   b. Ball-joint type
   c. Coil-spring supported
   d. Torsion-bar supported
   e. Anti-drive designs
   f. Anti-roll designs
3. Rear suspension systems
   a. Standard rear axle assembly
   b. Leaf-spring supported
   c. Coil-spring supported
   d. Independent rear suspension

D. Front Wheel Alignment Factors

1. Camber
   a. Definition
   b. Effect of camber on tire wear
   c. Application to the automobile
   d. Methods of adjustment
   e. Definition of a degree as a unit of measure
   f. Practical limits for specification
   g. Measuring devices and procedures
   h. Effect of camber on vehicle driving characteristics

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2. Caster

   a. Definition
   b. Application to the automobile
   c. Effect of caster on vehicle driving characteristics
   d. Effect of caster on tire wear
   e. Methods of adjustment
   f. Practical limits for specifications
   g. Measuring devices and procedures

3. Toe-in

   a. Definition
   b. Application to the automobile
   c. Effect of toe on vehicle driving characteristics
   d. Effect of toe on tire wear
   e. Methods of adjustment
   f. Specifications
   g. Measuring devices and procedures

4. Toe-out on turns (Steering geometry)

   a. Definition
   b. Application to the automobile
   c. Effect of toe-out on turns on vehicle driving characteristics
   d. Effect of toe-out on turns on tire wear
   e. Correction procedures
   f. Practical limits for specifications
   g. Measuring devices and procedures

5. Steering Axis Inclination

6. Rear Wheel Alignment Factors

   a. Rear wheel camber
   b. Definition
   c. Application to the automobile
   d. Effect of camber on vehicle driving characteristics
   e. Effect of camber on tire wear
   f. Methods of adjustment or correction
   g. Standard rear axle
   h. Independent suspension
   i. Specifications and practical limits
   j. Measuring devices and procedures

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7. Rear Wheel Toe

   a. Definition
   b. Application to the automobile
   c. Effect of rear wheel toe on vehicle driving characteristics
   d. Effect of rear wheel toe on tire wear
   e. Methods of adjustment or correction
   f. Tube axle
   g. Independent suspension
   h. Specifications and practical limits
   i. Measuring devices and procedures

8. Rear Wheel Track

   a. Definition
   b. Application to the automobile
   c. Effect of rear wheel tracking on vehicle driving characteristics
   d. Effect of rear wheel tracking on tire wear
   e. Methods of correction
   f. Tube axle-leaf spring
   g. Tube axle-coil spring
   h. Independent suspension
   i. Specifications and practical limits
   j. Measuring devices and procedures

9. Wheel Base Dimensions

   a. Front suspension members
   b. Rear suspension
   c. Standard rear axle
   d. Independent suspension

10. Specifications

    a. Information sources
    b. Practical limits

11. Measuring procedures

12. Correction procedures

    a. Check and adjust caster - camber - toe-in
    b. Check turning radius
    c. Check and adjust toe-in
    d. Check frame

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E. Differentials - Rear Axle

1. Differential

a. Types and identification
b. Construction, function and lubrication
c. Ratios - torque

2. Differential adjustments - methods

a. Pinion depth bearing preload
b. Tooth patterns - backlash
c. Axle bearing adjustments

3. Trouble shooting differentials

a. Road test
b. Locate gear and bearing noises

XI. AIR CONDITIONING

A. Basic Air Conditioning Theory

1. Nature of heat

a. Sensation of heat
b. Degree of heat - absolute zero-459.6°F
c. Quantity of heat
d. Radiant heat

2. Principle of heat transfer

a. Measurement of heat - BTU's
b. Conduction
c. Convection
d. Radiation

3. Change of state

a. Evaporation
b. Condensation
c. Latent heat
d. Latent heat of evaporation
e. Latent heat of condensation

4. Refrigerants

a. R 12
b. R 22
c. Safety precautions

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5. Pressure
   a. Atmospheric pressure
   b. Relation of pressure and temperature
6. Vacuum theory
7. Basic principles of refrigeration theory
   a. Principle of operation
   b. Low pressure side and components
   c. High pressure side and components
8. Air Conditioning system components theory
   a. Dehydrator and receiver
   b. Thermostatic expansion valves
   c. Evaporator
   d. Compressor
   e. Condenser
   f. Refrigerant R-12
   g. Magnetic clutch
   h. Temperature control valves and devices
   i. Air conditioning hoses
9. Trouble-shooting, diagnosis and servicing
   a. No cooling
   b. Improper air flow
   c. Compressor noise
   d. Connecting and reading manifold gauges
   e. Charging air conditioning system
   f. Evacuating the system
   g. Purging the system
   h. Testing air conditioning system for leaks
      1) Propane leak detector
      2) Electronic leak detector
   i. Discharging air conditioning system
   j. Checking compressor oil levels
10. Performance Testing the system
   a. Connecting and reading manifold gauges
   b. Adjusting controls

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XII. EMISSION CONTROLS

A. Introduction to Emission Controls

1. Air Pollution - cause and effect
   a. HC, CO, NO_{X1}, O_3, defined and explained

2. Sources of emissions and pollution
   a. Nature
   b. Manmade
      1) Industry
      2) Home
      3) Vehicles

3. Laws and regulations
   a. Federal
   b. State and local

4. Sources of vehicle emissions
   a. Crankcase
   b. Fuel system
   c. Exhaust system

B. Emission Control Systems

* 1. Crankcase emission controls
   a. Road draft tube
   b. PCV system

2. Types of PCV Systems
   a. Open PCV system
   b. Open PCV system (California type)
   c. Closed PCV system

3. Operation of PCV valve
   a. Starting mode
   b. Idle mode
   c. Moderate speed mode
   d. Heavy load mode

4. PCV System Testing and Service
   a. Quick-check of PCV (tach. method)
   b. PCV ramp type tester
   c. A.C. PCV system tester
   d. Replacing PCV valve
   e. Cleaning PCV system (filters, hoses)
   f. Inspection of PCV system
   g. Service and testing

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C. Exhaust Gas Emission Control System

* 1. Fuel Feed System

a. Carburetor designs
* b. Idle limiters
* c. Idle stop limiters
d. Idle speed solenoids
e. Deceleration throttle controls
f. Vacuum breaks (choke)
* g. Electric chokes
h. Staged choke pulldown

2. Combustion Changer and Manifold

a. Camshafts overlap
b. Valves, ports and valve arrangements
c. Intake manifold design
d. Quench area
e. Compression ration modification and effect.
f. Cooling system temperature
g. Service and testing

* 3. Ignition System Controls

a. Spark control conventional ignition system
* b. Spark control electronic ignition system
* c. Electronic ignition system

1) Reason and results

d. Temperature switches
* e. Transmission switches
f. Ported vacuum applications
g. Speed sensors
h. Solenoids
i. Time relays
j. Temperature relays
k. Spark relay valves
l. Solenoid control vacuum advance units
m. Service and testing

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D. Evaporative Emission Control System

* 1. Thermostatic Air Cleaners
    a. Principle and purpose
    b. Component parts
        1) Manifold shroud
        2) Flex connector
        3) Vacuum motor
        4) Heat control door
        5) Thermal vacuum valve
        6) Vacuum lines
    c. Testing and Service
        1) Inspect, clean or replace components
        2) Correct temperature of operation

  2. Fuel Evaporative System
    a. Fuel tank
    b. Tank venting
    c. Liquid vapor separators
    d. Fuel line
    e. Carbon cannister
    f. Carburetor bowl venting
    g. Service and testing
        1) Filters and lines
        2) Components

E. Air Injection System

* 1. System Components
    a. Air pump
    b. Air delivery and check valves
    c. Pressure relief valves
    d. Gulp valves
    e. Diverter valve
    f. Service and testing

F. Exhaust Gas Recirculation System

* 1. EGR Valve
  2. Coolant Temperature Switches
  3. Low and high temperature vacuum signal
  4. Service and testing

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G. Catalytic Converters
   1. Construction
      a. Pellet type
      b. Monolithic type
   2. Chemical principle
   3. Service and Testing

NOTE: The Emission Control Systems with an * have also been included in their appropriate job skill divisions.

XIII. MANUAL METAL ARC

A. Safety
   1. Personal
   2. Equipment
   3. Area

B. Manual Metal Arc Process
   1. Fusion (coalescence)
      a. Electric Arc
         1) Circuit
         2) Welding arc

C. Power Sources
   1. Alternating current (AC)
   2. Direct curr-nt (DC)
      a. DC reverse polarity
      b. DC straight polarity
   3. Types
      a. Motor generator sets; rectifiers; others
      b. Uses
   4. Associated equipment

D. Electrodes
   1. Identification
      a. Types
      b. Uses
      c. Polarity
      d. Positions

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E. Base Materials

1. Types

a. Ferrous
b. Non-ferrous

2. Weldability

a. Electrode types
b. Procedures

F. Fundamentals

1. Current settings

a. Amperage

2. Length of arc

a. Voltage

3. Angle of Electrode
4. Rate of travel

XIV. GAS WELDING - AUTOMOTIVE APPLICATION

A. Safety

1. Personal
2. Equipment
3. Area

B. Fundamentals

1. Tip size

a. Pressure
b. Flames

2. Tip and flame distance
3. Torch angles
4. Rate of travel

a. Filler wire deposit

5. Flux

C. Oxy-Acetylene Welding

1. Fusion created by heat of flame

a. Types of flames

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D. Brazing

1. Diffusion and alloying of filler material
   a. Filler-lower melting point than B/M
   b. Types of flames

E. Equipment

1. Regulators
   a. Types
2. Gases
3. Torches
   a. Types
4. Hoses
5. Fluxes
   a. Purpose
6. Filler
   a. Welding
   b. Brazing
7. Associated

F. Base Materials

1. Type B/M
   a. Flames adjustment
   b. Filler rod
   c. Flux